WHAT IS CLAIMED IS:

1. An integrated circuit including a composite polymer dielectric layer formed on a substrate, the composite polymer dielectric layer comprising:

a first silane-containing layer formed on the substrate, wherein the first silane-containing layer is formed at least partially from an organosilane material;

a low dielectric constant polymer layer formed on the first silane-containing layer; and

a second silane-containing layer formed on the low dielectric constant polymer layer.

2. The integrated circuit of claim 1, wherein the organosilane material is selected from materials having a general formula of $(RZ)_x$-Si-$(W\text{-}T)_y$, wherein W is selected from the group consisting of -O-, $-(CH_2)_a$--, $-(CH_2)_aC{=}OO$-, and $-(CH_2)_a$-OO=C-; wherein T is selected from the group consisting of -CR=CR'R", an alkyl halide, and -RC=O; wherein Z is selected from the group consisting of O and NR, wherein R, R' and R" are an H, alkyl or aromatic group; wherein a is 0 or an integer; wherein x = 1, 2 or 3; wherein y = 1, 2 or 3; and wherein x + y = 4.

3. The method of claim 1, wherein the organosilane material is selected from materials having a general formula of $H_xSi\text{-}(W\text{-}T)_y$, wherein W is selected from the group consisting of -O-, $-CH_2-$, $-(CH_2)_aC{=}OO-$, and $-(CH_2)_a-OO{=}C-$; wherein T is selected from the group consisting of -CR=CR'R", an alkyl halide, and -RC=O; wherein R, R' and R" are an H, alkyl or aromatic group; wherein a is 0 or an integer; wherein $x = 1, 2$ or 3; wherein $y = 1, 2$ or 3; and wherein $x + y = 4$.

4. The integrated circuit of claim 3, wherein the alkyl halide is selected from the group consisting of $-CH_xCl_y$, $-CH_xBr_y$, and $-CH_xI_y$

5. The integrated circuit of claim 1, wherein the organosilane material includes an acrylic functional group configured to form a covalent bond with the low dielectric constant polymer layer via a free radical mechanism.

6. The integrated circuit of claim 5, wherein the low dielectric constant polymer layer is covalently bonded to the first silane-containing layer and the second silane-containing layer.

7. The integrated circuit of claim 5, wherein the organosilane material is an acrylic silane.

8. The integrated circuit of claim 1, wherein the first silane-containing layer includes a plurality of silane groups having a general composition of $Si(ZR)_x$, wherein Z is O or NR and R is an alkyl or aromatic compound chemically bonded to the substrate.

9. The integrated circuit of claim 1, wherein the low dielectric constant polymer layer is formed from a fluorinated poly(paraxylylene)-based material.

10. The integrated circuit of claim 1, wherein the low dielectric constant polymer layer is formed via a free radical polymerization of a monomer having a general structure of X'_m-Ar-$(CZ'Z''Y')_n$, wherein Ar is an aromatic group or a fluorine-substituted aromatic group, wherein Z' and Z'' are selected from the group consisting of H, F and C_6H_5, wherein X' and Y' are leaving groups removable to generate free radicals, wherein m and n are each equal to zero or an integer, and wherein m + n is less than or equal to a total number of sp^2 hybridized carbons on Ar available for substitution.

11. The integrated circuit of claim 1, wherein X' and Y are selected from the group consisting of ketene and carboxyl groups, bromine, iodine, $-NR_2$, $-N^+R_3$, -SR, -SO_2R, -OR, $=N^+=N-$, $-C(O)N_2$, and $-OCF-CF_3$, wherein R is an alkyl or aromatic group.

12. The integrated circuit of claim 1, wherein the low dielectric constant polymer layer is formed from a material having a dielectric constant of less than 2.6.

13. The integrated circuit of claim 1, wherein the second silane-containing layer is formed from the same material as the first silane-containing layer.

14. The integrated circuit of claim 1, wherein the second silane-containing layer is formed from an acrylic silane, and wherein the second silane-containing layer is chemically bonded to the low dielectric constant polymer layer via a free radical reaction between a vinyl functional group on the vinyl silane and a free radical on the low dielectric constant polymer layer.

15. The integrated circuit of claim 1, wherein the second silane-containing layer includes an outer surface with a plurality of silane groups having a general composition of $Si(ZR)_x$, wherein Z is O or NR and R is an alkyl or aromatic compound.

16. The integrated circuit of claim 1, wherein the first silane-containing layer has a thickness of between one molecular layer and 50 nanometers.

17. The integrated circuit of claim 16, wherein the first silane-containing layer has a thickness of approximately 5 nanometers.

18. The integrated circuit of claim 1, wherein the low dielectric constant polymer layer has a thickness of between 10 and 3000 nanometers.

19. The integrated circuit of claim 18, wherein the low dielectric constant polymer layer has a thickness of between 100 and 300 nanometers.

20. The integrated circuit of claim 1, wherein the second silane-containing layer has a thickness of between one molecular layer and 200 nanometers.

21. The integrated circuit of claim 20, wherein the second silane-containing layer has a thickness of approximately 50 nanometers.

22. An integrated circuit including a composite polymer dielectric layer, the composite polymer dielectric layer comprising:

a first adhesion promoter layer formed from a first organosilane material having at least one unsaturated bond capable of free radical polymerization, wherein the first adhesion promoter layer is chemically bonded to an underlying silicon-containing layer;

a low dielectric constant polymer layer formed on and chemically bonded to the first adhesion promoter layer; and

a second adhesion promoter layer formed from a second organosilane material having at least one unsaturated bond capable of free radical polymerization, wherein the second adhesion promoter layer is formed on and chemically bonded to the low dielectric constant layer.

23. The integrated circuit of claim 22, wherein the first organosilane material and the second organosilane material are the same organosilane material.

24. The integrated circuit of claim 23, wherein the organosilane material is a vinyl silane.

25. The integrated circuit of claim 24, wherein the vinyl silane is an acrylic silane.

26. The integrated circuit of claim 24, wherein the organosilane material is selected from materials having a general formula of $(RZ)_x$-Si-$(W\text{-}T)_y$, wherein W is selected from the group consisting of –O-, -CH_2-, -$(CH_2)_a$C=OO-, and -$(CH_2)_a$-OO=C-; wherein T is selected from the group consisting of -CR=CR'R", an alkyl halide, and -RC=O; wherein Z is selected from the group consisting of O and NR, wherein R, R' and R" are an H, alkyl or aromatic group; wherein a is 0 or an integer; wherein x = 1, 2 or 3; wherein y = 1, 2 or 3; and wherein x + y = 4..

27. The integrated circuit of claim 22, wherein low dielectric constant polymer layer is formed from a polymer material having a dielectric constant of less than 2.6.

28. The integrated circuit of claim 22, wherein the low dielectric constant polymer layer is formed from a poly(paraxylylene) having a general formula of -(-C(F_xH_{2-x})-$(C_6F_yH_{4-y})$-C(F_xH_{2-x})-)-, wherein x = 0, 1 or 2, and wherein y = 0, 1, 2, 3 or 4.

29. The integrated circuit of claim 22, wherein the low dielectric constant polymer layer is formed via polymerization of a diradical monomer having a general formula of Ar-$(CZ'Z''^{*})_2$, wherein Ar is an aromatic group or a fluorine-substituted aromatic group, and wherein Z' and Z'' are selected from the group consisting of H, F and C_6H_5.

30. The integrated circuit of claim 22, wherein the first adhesion promoter layer is chemically bonded to the underlying silicon-containing layer via a plurality of Si-Z-Si bonds, wherein Z is selected from the group consisting of O or NR, and wherein R is an alkyl or aromatic compound.

31. The integrated circuit of claim 22, wherein the first adhesion promoter layer is chemically bonded to the low dielectric constant polymer layer via a free radical reaction between the unsaturated bond on the organosilane material and a free radical on the low dielectric constant polymer layer.

32. The integrated circuit of claim 22, wherein the first adhesion promoter layer has a thickness of between one molecular layer and 50 nanometers.

33. The integrated circuit of claim 22, wherein the polymer dielectric layer has a thickness of between one molecular layer and 3000 nanometers.

34. The integrated circuit of claim 22, wherein the second adhesion promoter layer has a thickness of between one molecular layer and 200 nanometers.

35. A method of making an integrated circuit, the integrated circuit including a composite dielectric layer having a first silane-containing layer, a second silane-containing layer, and a low dielectric constant polymer layer disposed between the first and second silane-containing layers, the method comprising:

depositing the first silane-containing layer on the substrate;

depositing the low dielectric constant polymer layer on the first silane-containing layer; and

depositing the second silane-containing layer on the low dielectric constant polymer layer.

36. The method of claim 35, wherein the low dielectric constant polymer layer is deposited by exposing the first silane-containing layer to a concentration of a gas phase diradical, and condensing and polymerizing the gas phase monomer on the first silane-containing layer.

37. The method of claim 36, wherein the substrate is maintained below a crystallization temperature of the low dielectric constant polymer layer while the low dielectric constant polymer layer is being deposited.

38. The method of claim 36, wherein the low dielectric constant polymer layer is at least partially formed from a poly(paraxylylene) having a general formula of -(-$C(F_xH_{2-x})$-$(C_6F_yH_{4-y})$-$C(F_xH_{2-x})$-)-, wherein x = 0, 1 or 2, and wherein y = 0, 1, 2, 3 or 4.

39. The method of claim 38, wherein the gas phase monomer is a diradical a diradical monomer having a general formula of Ar-(CZ'Z''*)$_2$, wherein Ar is an aromatic group or a fluorine-substituted aromatic group.

40. The method of claim 39, wherein the substrate is maintained at a temperature below the crystallization temperature of the diradical while the low dielectric constant polymer layer is deposited.

41. The method of claim 40, wherein the substrate is maintained at a temperature of between -30 and -50 degrees Celsius while the low dielectric constant polymer layer is deposited.

42. The method of claim 35, wherein the first silane-containing layer is formed at least partially from an organosilane material selected from materials having a general formula of $(RZ)_x$-Si-(W-T$)_y$, wherein W is selected from the group consisting of –O-, -CH_2-, -$(CH_2)_a$C=OO-, and -$(CH_2)_a$-OO=C-; wherein T is selected from the group consisting of -CR=CR'R", an alkyl halide, and -RC=O; wherein Z is selected from the group consisting of O and NR, wherein R, R' and R" are an H, alkyl or aromatic group; wherein a is 0 or an integer; wherein x = 1, 2 or 3; wherein y = 1, 2 or 3; and wherein x + y = 4.

43. The method of claim 42, wherein the substrate contains silicon, and wherein the first silane-containing layer is chemically bonded to the substrate via a plurality of Si-Z-Si bonds (Z = O or NR, where R is an alkyl or aromatic compound) formed between silane groups in the first silane-containing layer and the silicon in the substrate.

44. The method of claim 35, further comprising exposing the first silane-containing layer to at least one of UV radiation and heat before depositing the low dielectric constant polymer layer to create free radicals from vinyl groups in the first silane-containing layer.

45. The method of claim 35, further comprising exposing the second silane-containing layer to at least one of UV radiation and heat after depositing the second silane-containing layer to chemically bond the second adhesion promotion layer to the low dielectric constant polymer layer.

46. The method of claim 35, further comprising heating the composite dielectric layer in the presence of hydrogen after depositing the second silane-containing layer.

47. The method of claim 46, wherein heating the composite dielectric layer under hydrogen includes heating the composite dielectric layer under a mixture of 3-10% hydrogen in an inert gas.

48. The method of claim 46, further comprising exposing the second silane-containing layer to thermal energy to chemically react the second silane-containing layer with the low dielectric constant polymer layer before heating the composite dielectric layer in hydrogen.

49. The method of claim 46, further comprising exposing the second silane-containing layer to UV radiation before heating the composite dielectric layer in the presence of hydrogen to react the second silane-containing layer with the low dielectric constant polymer layer.

50. The method of claim 46, wherein the composite dielectric layer is heated under hydrogen for 0.5-10 minutes

51. The method of claim 50, wherein the composite dielectric layer is heated under hydrogen for 3-4 minutes.

52. The method of claim 46, wherein the composite dielectric layer is heated under hydrogen to a temperature of 300-400 degrees Celsius.

53. The method of claim 35, wherein the substrate includes a surface, further comprising exposing the substrate to UV radiation before depositing the first silane-containing layer to remove water from the substrate surface.

54. A method of making an integrated circuit, the integrated circuit including an adhesion promoter layer disposed on a substrate and a low dielectric constant polymer layer disposed on the adhesion promoter layer, the method comprising:

depositing a silane material onto the substrate;

exposing the adhesion promoter layer to a free radical generating energy source to generate free radicals from vinyl functional groups on the silane material, wherein some free radicals react to form adhesion promoter layer, and wherein other free radicals are available to react with the low dielectric constant polymer layer;

depositing the low dielectric constant polymer layer on the adhesion promoter layer by exposing the substrate to a concentration of a gas phase free radical, wherein at least some of said other free radicals react with the low dielectric constant layer as it is deposited; and

heating the adhesion promoter layer and the polymer dielectric in the presence of hydrogen.

55. The method of claim 54, wherein the low dielectric constant polymer layer is deposited while the substrate is held at a temperature of between approximately -30 and -50 degrees Celsius.

56. The method of claim 55, wherein the low dielectric constant polymer layer is deposited while the substrate is held at a temperature of between approximately -30 and -50 degrees Celsius.

57. The method of claim 54, wherein the adhesion promoter layer is a first adhesion promoter layer, further comprising depositing a second adhesion promoter layer on low dielectric constant polymer layer before heating under hydrogen.

58. The method of claim 57, further comprising exposing the second adhesion promoter layer to free radical generating energy after depositing the second adhesion promoter layer.

59. The method of claim 58, wherein the free radical generating energy is UV light.

60. The method of claim 54, wherein the silane material is selected from materials having a general formula of $(RZ)_x$-Si-$(W-T)_y$, wherein W is selected from the group consisting of –O-, -CH_2-, -$(CH_2)_aC$=OO-, and -$(CH_2)_a$-OO=C-; wherein T is selected from the group consisting of -CR=CR'R", an alkyl halide, and -RC=O; wherein Z is selected from the group consisting of O and NR, wherein R, R' and R" are an H, alkyl or aromatic group; wherein a is 0 or an integer; wherein x = 1, 2 or 3; wherein y = 1, 2 or 3; and wherein x + y = 4..

61. The method of claim 54, wherein the low dielectric constant polymer layer is formed from a polymer material having a dielectric constant of less than 2.6.

62. The method of claim 61, wherein the low dielectric constant polymer layer is formed from a poly(paraxylylene) having a general formula of -(-$C(F_xH_{2-x})$-$(C_6F_yH_{4-y})$-$C(F_xH_{2-x})$-)-, wherein x = 0, 1 or 2, and wherein y = 0, 1, 2, 3 or 4.

63. The method of claim 62, wherein the low dielectric constant polymer layer is formed from a poly(paraxylylene)-based material having a general structure of -(CF_2-(C_6H_4)-CF_2)-, and wherein the low dielectric constant polymer layer is deposited with an initial crystallinity of at least 20% in a β_2 phase of the material.

64. The method of claim 54, wherein the low dielectric constant polymer layer is formed from a monomer having a general formula of X'_m-Ar-$(CZ'Z''Y')_n$, wherein Ar is an aromatic group or a fluorine-substituted aromatic group, wherein Z' and Z'' are selected from the group consisting of H, F and C_6H_5, wherein X' and Y' are leaving groups removable to generate free radicals, wherein m and n are each equal to zero or an integer, and wherein $m + n$ is less than or equal to a total number of sp^2 hybridized carbons on Ar available for substitution.

65. The method of claim 54, further comprising exposing the substrate to ultraviolet radiation before depositing the silane material onto the substrate to remove water from a surface of the substrate.

66. The method of claim 54, wherein heating the adhesion promoter layer and the low dielectric constant polymer layer in the presence of hydrogen includes heating the adhesion promoter layer and the low dielectric constant polymer layer under a mixture of 3-10% hydrogen in an inert gas.

67. The method of claim 54, wherein the adhesion promoter layer and the low dielectric constant polymer layer are heated under hydrogen for 0.5-10 minutes.

68. The method of claim 54, wherein the adhesion promoter layer and the low dielectric constant polymer layer are heated under hydrogen for 3-4 minutes.

69. The method of claim 54, wherein the adhesion promoter layer and the low dielectric constant polymer layer are heated under hydrogen to a temperature of 300-400 degrees Celsius.

70. The method of claim 54, wherein the adhesion promoter layer and the low dielectric constant polymer layer are heated under hydrogen to a temperature of 350-400 degrees Celsius.

71. A method of making an integrated circuit, the integrated circuit including a polymer dielectric layer disposed on an underlying silicon-containing layer, comprising:

exposing the silicon-containing layer to UV radiation;

depositing the polymer dielectric layer on the silicon-containing layer after exposing the silicon-containing layer to UV radiation by exposing the substrate to a concentration of a gas-phase free radical; and

heating the polymer dielectric layer in a presence of hydrogen, wherein heating the polymer dielectric layer in the presence of hydrogen caps unreacted free radicals with hydrogen.

72. The method of claim 71, wherein the gas-phase free radical is a diradical having a diradical monomer having a general formula of Ar-$(CZ'Z''^{*})_2$, wherein Ar is an aromatic group or a fluorine-substituted aromatic group.

73. The method of claim 71, wherein the polymer dielectric layer has a dielectric constant of less than 2.6.

74. The method of claim 71, further comprising depositing an adhesion promoter layer over the polymer dielectric layer, wherein the adhesion promoter layer is formed at least partially from a silane material selected from materials having a general formula of $(RZ)_x$-Si-$(W\text{-}T)_y$, wherein W is selected from the group consisting of -O-, -CH_2-, -$(CH_2)_a$C=OO-, and -$(CH_2)_a$-OO=C-; wherein T is selected from the group consisting of -CR=CR'R", an alkyl halide, and -RC=O; wherein Z is selected from the group consisting of O and NR, wherein R, R' and R" are an H, alkyl or aromatic group; wherein a is 0 or an integer; wherein x = 1, 2 or 3; wherein y = 1, 2 or 3; and wherein x + y = 4.

75. The method of claim 74, further comprising exposing the adhesion promoter layer to a free radical generating energy source to generate free radicals from vinyl groups in the adhesion promoter layer to chemically bond with unreacted free radicals in the adhesion promoter layer before heating in the presence of hydrogen.

76. The method of claim 75, wherein the free radical generating energy source is a UV light source.

77. The method of claim 75, wherein the free radical generating energy source is a thermal energy source.

78. The method of claim 71, further comprising depositing an adhesion promoter layer on the silicon-containing layer before depositing the polymer dielectric layer.